# U.S. PATENT APPLICATION

FOR

# PROCESS FOR PRODUCING A CHANNEL CLEANING BRUSH FOR CLEANING AN ENDOSCOPE OPERATING CHANNEL

BY

**Jean-Paul Durand, Alain Lloze, and Jacques Oblin**

## FIELD OF THE INVENTION

This invention relates to endoscopes. More particularly, this invention relates to the operating channels of these endoscopes.

## BACKGROUND

Endoscope operating channels make it possible to move biopsy pincers to an operating site in order to take tissue samples at that location.

Repeated passage of the biopsy pincers into the operating channels, and in particular the passage of rigid elements of these devices into curves formed by the channels once introduced into the

human body, has damaging effects on the operating channels. These effects include scraping of the internal walls, creation of diverticula therein, creation of perforations therein, and even promotion of the creation of biofilms by coating the walls thereof, thus increasing the risks of contamination of the pincers before they arrive at the operating site.

In order to prevent these effects or risks, i.e. in order, after each usage, to remove the biofilm which may have been deposited, it is normal practice to use channel cleaning brushes, which are small brushes with handles similar to those used domestically for cleaning bottles or other containers.

For such usage the brushes are formed by attaching a group of synthetic material bristles to flexible "handles" or flexible cores that are sufficiently long to permit the brushes to pass from one end of the channel to the other.

Channel cleaning brushes are produced and packaged singly. In addition, their manufacture involves several production phases including at least preparation of the cores and the brushes, mounting of the brushes onto the cores, and packaging of the channel cleaning brush. These constraints make cleaning of the operating channels expensive, especially since the channel cleaning brushes are thrown away after every use.

US 5 964 004 discloses cleaners for tubes such as endoscope operating channels, and proposes blades on a sheath mounted on a flexible core, the blades and the sheath being integrally moulded on the flexible core and being made of rubber or synthetic material, the core being a

steel wire.

WO01 28406 proposes materials that can be used and means of attaching a brush to a core, which is a filament of extruded propylene onto which the brush is over-moulded.

The applicant has sought to provide a greater reduction in the manufacturing costs for channel cleaning brushes.

## SUMMARY OF THE INVENTION

The invention relates to a process for producing a channel cleaning brush for cleaning an endoscope operating channel, including mounting on a flexible core at least one synthetic material brush having a cleaning coil disposed on a shaft. Preferably, the synthetic material brush is over-moulded onto the core. The process is characterised by the fact that a plurality of brushes may be over-moulded onto the core.

Preferably, the core is pre-cut between two brushes, allowing the core to be cut and separated into two strands.

Preferably, a pre-cutting point connector including a breaking point between the two strands is over-moulded onto the core.

## BRIEF DESCRIPTION OF THE FIGURES

The invention will be better understood with the aid of the following description and of the

accompanying drawings, in which:

- **Figure 1** is a simplified view of a channel cleaning brush in accordance with the invention;

- **Figure 2** shows a transverse cross-sectional view of a channel cleaning brush in front of the last fin;

- **Figure 3** shows a perspective view of elements of the mould;

- **Figure 4** shows a partial axial cross-sectional view of a brush;

- **Figure 5** shows the principle of manufacture and packaging of a group of channel cleaning brushes;

- **Figure 6** shows an example of a pre-cutting segment; and

- **Figure 7** shows a perspective view of an example of a half-mould.

## DETAILED DESCRIPTION OF THE INVENTION

With reference to **Figure 1**, channel cleaning brush **1** has a core **10** of synthetic material thread such as Teflon or polytetrafluoroethylene (PTFO), which is flexible and of good mechanical quality, on which a brush **15** is attached, itself being formed by a shaft **20** bearing brushing or scraping fins **21**. The brush **15** is in this case made as a single piece of moulded synthetic material, for example, low density polyethylene, the flexibility of which permits the walls of the operating channel to be brushed without damaging or deforming them.

The fins shown in **Figure 2** are of a shape covering substantially one sector, in the case of fins with only one blade, or n sectors, in the case of fins with n blades, of the transverse cross-section of the operating channel of which they are intended to scrape the walls.

**Figure 2** shows the relative placement of the fins **21**, in this case in two sectors of substantially an angle $\alpha$ with respect to the centre, which are inscribed in a circle with a diameter **D** corresponding to the diameter of the section of the channel to be scraped, or a little greater; its shaft **20** to which it is attached, with a diameter **d**; and the core 10 of the channel cleaning brush.

As shown in **Figure 4**, which is a partial axial cross-section of a brush, the fins **21** are regularly disposed axially on the shaft **20**, spaced apart from each other by a distance **e** which is not particularly large, for example equal to **D-d**.

Similarly the fins **21** are regularly disposed in an angled manner, i.e. two successive fins **21** are axially rotated by an angle $\alpha$ in relation to each other. For this reason it is possible to refer to a cleaning coil although the fins themselves are not twisted.

In the example of **Figure 2**, the angle $\alpha$ is equal to $\pi/2$, and the fin **21** following the fin shown would cover the angle $\beta$ of the figure.

Thus in this example two successive fins with two blades would be sufficient to scrape the whole wall of the channel.

More generally, a brush will be formed by at least $2\pi/(n\alpha)$ fins with n blades to cover the whole periphery of the wall.

In this case there is a preference for n = 2 blades and an angle $\alpha$ equal to $\pi/2$, which achieves an

advantage during manufacture since a single cutting plane **40** is provided, illustrated in **Figures 2** and **4**, for all the fins in their final position on the shaft of the brush.

Thus it is possible to mould the fins **21** and the shaft **20** simultaneously in order to produce a single unified piece. Moreover, a mould **30'**, **30"**, shown in **Figure 5**, is provided to over-mould the brushes **15** directly onto the flexible core **10** of the channel cleaning brush.

The over-moulding operation is of the fusion diecasting type in this case.

The core **10** is held taut between a supply spool **50** dispensing PTFO thread (to serve as the core) and a receiving spool **60** receiving the formed channel cleaning brushes, which are ready for dispatch. Between the two spools the mould **30'**, **30"** over-moulds the brushes **15** onto the thread **10** by means of depressions **32a**, **32b**, shown in **Figure 3**, at locations predetermined by the advancement of the thread between the two spools and the position of the depressions in the mould. The brushes are fixed to the core in a purely thermal manner, with the temperature reached during the over-moulding operation, which is effected by fusion, causing superficial melting of the PTFO thread. Pre-cutting points for the core **10** at the ends **2, 3** of the channel cleaning brushes are formed simultaneously with the brushes at predetermined sites **70** relative to the depressions **32a**, **32b** in the mould, these pre-cutting points being located between two brushes **15** so that the brushes can be separated when about to be used.

**Figure 6** shows a particular embodiment of these pre-cutting points in which the PTFO thread of the core **10** is cut at **11**, the two strands **10'**, **10"** are separated in order to leave a gap **12**

between them, and a connector **23**, itself including a breaking point **24** between the two strands, is over-moulded onto the two strands **10'**, **10"** while preserving this gap.

Users are thereby provided with spools of channel cleaning brushes which are very easy to use.

The manufacturing tool for such a connector in the tool for manufacturing the brushes described hereinunder can easily be produced.

It is also necessary to provide a knife for cutting the core, pincers for grasping the two ends thus obtained and means for separating these ends by the gap **12** and positioning them on both sides of the pre-cutting point **70** of the mould. It is also necessary to control these means before the moulding operation itself.

The mould itself must comprise the depressions for these segments at the sites **70**.

It would also be possible to dispense with pre-cutting segments, allowing the user to cut the channel cleaning bushes himself but this would remove one of the advantages of the invention.

In **Figure 3** the mould **30'**, **30"** has two complementary blocks **30'**, **30"** corresponding to two half moulds. When in contact the two blocks are separated at their contact face by a cutting plane **40**, partially illustrated in **Figure 4** and indicated in **Figure 2**. A block **30'** or **30"** is formed by a stack of elements **31a, 31b**, each element having two halves **32a**, **32b** that are half the thickness of a fin depression, with the stacked arrangement producing the full thicknesses,

and the two blocks forming the complete depressions. The two depression halves **32a**, **32b** are connected by a half-depression **38** for a segment of the shaft of the brush. This design requires termination elements having only half the depression thickness. It is possible to design elements (not shown) having only the complete thickness of a half-depression. The termination blocks are thus no longer necessary.

It is also possible to design (**Figure 7**) half-moulds **100** that are non-modular.

For other types of fins the design of the mould would be more complex.

The process for producing the channel cleaning brushes is consequently the following:

assuming that the flexible core **10** is in place in the open mould **30'**, **30''**,

1) the brush or brushes **15** are over-moulded onto this flexible core after having closed the two blocks **30'**, **30''** one on the other, the brushes being over-moulded and at the same time thermally fixed at locations predetermined by the position of the core in the mould,

2) a pre-cutting point connector **23**, **24** for the core **10** is simultaneously moulded at a predetermined location **70** on the channel cleaning brush,

3) the mould **30'**, **30''** is opened and the brush or brushes **15** are demoulded,

4) the supply spool **50** is turned to unwind the core **10** with no brushes applied by a length of

flexible core corresponding to a moulding operation, this length being positioned in the block **30'**,

5) and the receiving spool **60** is turned simultaneously by the length of the core corresponding to the moulding operation which has just been effected to wind the core bearing the brushes by a corresponding length.